

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

Have later edition

U. S. DEPARTMENT OF
AGRICULTURE

FARMERS' BULLETIN No. 1609

LETTUCE
GROWING



CRISP TENDER LETTUCE, especially of the hard-heading varieties, has increased in popularity during recent years. The markets, however, are now well supplied during the greater part of the year. Head lettuce is grown on a large scale under irrigation in certain of the more favorable sections of the Western States, but very fine and profitable crops are being produced by eastern growers. Lettuce is one of the most exacting of the vegetable crops as regards soil and climatic conditions.

The problem of growing good head lettuce in the East is to mature the crop before hot weather and while the nights are relatively cool. Tremendous yields of both head and loose-leaf lettuce are frequently made in the open ground by eastern growers, especially where the plants are started in greenhouses or in slightly heated frames and transplanted to the open. Fall crops are grown by sowing the seed in place and thinning the plants to a uniform stand.

The commercial outdoor lettuce crop consists mainly of five or six varieties which are being constantly selected and improved for greater uniformity and adaptation to climatic conditions and market requirements. Green or leaf lettuce is considered of great value as a source of vitamin A, and this type of lettuce is especially recommended for growing in home gardens.

LETTUCE GROWING

By W. R. BEATTIE, *Senior Horticulturist, Office of Horticultural Crops and Diseases, Bureau of Plant Industry*

CONTENTS

	Page		Page
Acres and production of lettuce.....	1	Thinning.....	17
Factors governing the field production of lettuce.....	3	Cultivation.....	18
Rotations.....	4	Irrigation.....	19
Manures and fertilizers.....	4	Insect enemies of the lettuce crop.....	21
Time.....	5	Diseases.....	22
Soil preparation.....	6	Preparation for market.....	23
Varieties.....	7	Marketing loose-leaf lettuce.....	27
Seed supply.....	12	Some economic aspects of lettuce production.....	28
Planting.....	13		

ACREAGE AND PRODUCTION OF LETTUCE

THE ACREAGE PLANTED to the commercial lettuce crop of the United States in 1928, according to statistics recorded in the 1928 Yearbook of the United States Department of Agriculture, was 126,780 acres. The product of this area was 18,589,000 crates of four dozen heads each, valued at \$31,601,300. This, however, does not include small lots of lettuce grown and marketed locally. Lettuce is grown on a large scale in no less than 15 States, but the bulk of the carload shipments originates in 10 States. The reported carload movement of lettuce during 1928 was approximately 51,000 cars.

Table 1 shows the yearly carload movement of lettuce from 1920 to 1928. Carload shipments of lettuce increased more than threefold during this period. In 1928 California shipped more than 33,000 cars of lettuce, or more than half of the entire movement for the country. New York, Washington, Arizona, and Colorado were the other important producing States in 1928.

TABLE 1.—*Lettuce: Car-load shipments by State of origin, 1920-1928*¹

State	1920	1921	1922	1923	1924	1925	1926	1927	1928 ²
	<i>Cars</i>	<i>Cars</i>	<i>Cars</i>	<i>Cars</i>	<i>Cars</i>	<i>Cars</i>	<i>Cars</i>	<i>Cars</i>	<i>Cars</i>
New York.....	1,775	3,240	3,167	3,817	3,098	3,821	3,019	3,406	3,138
New Jersey.....	208	469	571	450	417	463	308	308	144
North Carolina.....	207	445	622	718	714	537	540	447	477
South Carolina.....	121	716	987	577	423	736	372	369	241
Florida.....	2,940	2,267	3,323	3,146	2,257	1,519	987	920	813
Idaho.....	25	180	880	1,241	532	501	308	196	67
Colorado.....	129	234	812	1,436	1,036	3,096	2,795	2,848	2,368
Arizona.....	254	168	678	1,108	2,049	3,519	4,906	9,131	9,204
Washington.....	354	635	812	1,081	674	820	904	1,151	1,232
California.....	7,358	9,850	9,744	15,113	18,480	21,618	27,341	27,574	33,446
Other States.....	417	534	635	702	655	676	540	401	316
Total.....	13,788	18,738	22,240	29,485	30,935	37,306	42,105	46,850	51,446

¹ UNITED STATES DEPARTMENT OF AGRICULTURE, STATISTICAL COMMITTEE. AGRICULTURAL STATISTICS. U. S. Dept. Agr. Yearbook 1928: 301. 1929.
² Preliminary.

Table 2 shows the acreage, yield, and price per crate, by States, for the years 1925 to 1928, inclusive. Although there exists considerable price variation in the figures given, the general average for the 4 years was fairly uniform. The figures in Table 1 show that during the past few years there has been an enormous increase in the carload movement of lettuce, a part of which may be due to the extension of the industry to new territory, but more especially is it due to increased demand for this type of food.

TABLE 2.—*Lettuce, commercial crop: Acreage, production, and price per crate, by States, 1925-1928*¹

Season and State	Acreage				Production				Price per crate ²			
	1925	1926	1927	1928	1925	1926	1927	1928	1925	1926	1927	1928
Early:												
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>1,000 crates</i>	<i>1,000 crates</i>	<i>1,000 crates</i>	<i>1,000 crates</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>
Arizona ³	6,400	8,300	14,800	28,700	1,440	1,912	3,034	3,372	1.06	1.90	1.35	1.6
California—												
Imperial ⁴	23,000	28,000	34,400	22,000	4,600	4,900	5,229	3,740	1.71	1.95	1.34	1.62
Other.....	24,680	37,100	42,010	20,570	4,368	5,565	6,049	7,636	1.16	1.37	1.75	1.84
Florida ⁴	3,400	1,500	1,840	1,850	765	252	294	314	1.41	2.21	1.62	1.61
North Carolina.....	1,730	1,420	1,490	1,490	467	379	207	216	1.98	2.00	1.87	1.60
South Carolina.....	1,480	780	700	750	247	133	158	112	1.69	1.81	1.59	2.11
Texas ⁴	680	640	900	1,000	68	72	100	100	1.38	1.19	1.00	1.62
Virginia.....	300	300	300	300	39	30	50	60	2.07	1.70	1.50	1.43
Total.....	61,670	78,240	96,400	106,600	11,994	13,251	15,124	15,450	1.42	1.70	1.37	1.58
Late:												
Colorado.....	10,500	13,240	13,240	9,800	1,396	1,533	1,456	1,127	1.58	1.43	1.63	1.07
Idaho.....	1,300	1,300	1,129	900	180	157	218	101	1.86	1.47	.96	1.67
New Jersey.....	2,300	2,400	2,450	2,300	541	593	612	442	1.64	1.08	2.04	1.80
New Mexico.....	1,400	1,000	419	400	280	77	59	18	1.70	1.66	.75	1.62
New York.....	6,820	7,200	5,540	4,400	1,323	1,246	1,457	1,004	1.42	1.60	1.48	2.68
Oregon.....	300	300	300	100	45	18	15	7	1.92	1.42	1.25	1.70
Pennsylvania.....	70	80	80	80	11	12	10	9	2.50	1.34	1.50	2.70
Washington.....	1,450	1,000	2,050	2,040	290	336	410	428	2.50	1.36	1.48	1.20
Wyoming.....	110	210	200	40	16	27	22	3	1.50	1.40	1.20	1.82
Total.....	24,560	27,320	25,360	20,120	4,082	3,969	4,250	3,139	1.63	1.43	1.57	1.70
Grand total.....	86,230	105,560	121,760	126,720	16,076	17,220	19,374	18,589	1.48	1.64	1.42	1.70

¹ UNITED STATES DEPARTMENT OF AGRICULTURE, STATISTICAL COMMITTEE. AGRICULTURAL STATISTICS. U. S. Dept. Agr. Yearbook 1927: 876. 1928.

² Average for season.

³ Crates of 4 dozen heads each.

⁴ Harvest of crops begins in fall previous year.

Of the 126,780 acres reported for the commercial lettuce crop during 1928, only about 12,000 were in the eastern United States. As already suggested, this does not include the many small areas in which lettuce is grown and marketed locally, and the total lettuce production in the eastern United States is of much greater importance than the figures would indicate.

On the basis of the farm value of lettuce for 1928, as computed by the United States Department of Agriculture, this crop ranked third among all vegetables, being exceeded by potatoes and sweet potatoes. Table 1 shows an annual increase of nearly 5,000 cars of lettuce shipped to the markets during the period from 1920 to 1928.

Lettuce is one of the most intensive of the vegetable crops in the United States, yielding a large return per acre, but involving high production costs. Lettuce production for the market is divided into three classes: Western outdoor lettuce, eastern outdoor lettuce, and that grown in greenhouses and coldframes. This bulletin deals

mainly with the outdoor production of lettuce in the eastern United States, with brief reference to the methods employed in the western area.¹

It should be noted that during recent years there has been a great increase in the demand for the hard-heading western lettuce, mainly of the New York and Iceberg varieties. The increase in popularity of the solid-head lettuce has been due to its tender crisp nature when well grown and the comparative ease with which it can be delivered in good condition to distant markets. The green, loose-headed, and leaf varieties of lettuce have a higher vitamin content; but the hard-headed varieties, owing to their habit of close growth, are more hardy and less subject to injury in handling.

FACTORS GOVERNING THE FIELD PRODUCTION OF LETTUCE

Temperature, moisture, and soil are important contributing factors in the successful production of outdoor lettuce. Temperature is probably most frequently the limiting factor, since it is practically beyond control, while soil and moisture can often be modified to suit the crop. Lettuce requires a relatively low average temperature with freedom from periods of excessive heat, especially after the heads begin to form. Any good trucking soil will grow lettuce, provided moisture and plant-food conditions are suitable. Soil requirements consist of (1) adaptability to intensive cultivation, (2) capacity to retain moisture, and (3) an abundance of plant food. Good drainage is essential, and where the natural rainfall is insufficient or not well distributed some form of irrigation is desirable as crop insurance.

The greater part of the outdoor lettuce grown in the States bordering on the Great Lakes is produced on the peat soils, while that grown in the New England States and the southeastern part of the United States is grown mainly on lighter sandy loams. The great lettuce fields of the western coast are located mainly on alluvial and semi-alluvial soils of a texture varying from sandy loams to heavy clay silt loams.

Climatic conditions suitable for growing lettuce during the winter months are found in the southern part of Florida, in the Imperial Valley of California, and in parts of Arizona and Texas. The climate of the central section of California and of the greater part of the Atlantic Coast is adapted to the growing of early-spring and late-fall lettuce, whereas the best summer lettuce is grown at high altitudes in Colorado and Idaho and in the Great Lakes region. In these several localities and at different seasons of the year suitable climatic conditions prevail for the production of head lettuce, so that a practically continuous supply is available.

In the western lettuce-growing section the crop is produced almost entirely under irrigation. In the eastern part of the United States natural rainfall is frequently supplemented either by subirrigation or by an overhead sprinkler system. Much of the eastern lettuce acreage, however, is dependent entirely upon natural rainfall, especially on the peat lands of the Great Lakes region.

¹The production of lettuce in greenhouses is discussed in the following publication: BEATTIE, J. H. LETTUCE GROWING IN GREENHOUSES. U. S. Dept. Agr. Farmers' Bul. 1418, 22 p., illus. 1924. The culture of lettuce in California, Arizona, and Colorado is discussed in bulletins issued by those States.

ROTATIONS

Crop rotation in lettuce growing has proved to be of value, both in the control of diseases and in the maintenance of soil fertility and physical conditions through the use of green manures. There are certain diseases, briefly considered in this bulletin, that cause serious losses to the lettuce crop, both in the field and in transit, and crop rotation is one of the means of preventing the development of these diseases. Cases are on record, however, where five to eight successive spring and fall crops of lettuce have been grown on the same piece of land without serious losses from diseases.

Although it would be impossible to outline definite rotations, because of the various conditions under which lettuce is grown, it should be the practice of the grower to plant lettuce on a given piece of land not oftener than once or twice in three or four years. Some growers follow the practice of planting a fall and a spring crop of lettuce on the same piece of ground, then utilizing this particular piece of ground for other crops for at least two years. Soil-building crops, such as cowpeas, soybeans, velvetbeans, rye, vetch, and sorghum, may be employed to advantage for maintaining the humus content of the soil. Field corn should not be grown in rotation with lettuce, as it draws too heavily upon the plant-food supply of the soil. In the Western States land on which alfalfa has been turned under is considered excellent for lettuce.

MANURES AND FERTILIZERS

Lettuce requires a large supply of plant food in the soil, and the most successful lettuce growers, especially those of the eastern United States, use stable manure in large quantities whenever it can be obtained at a reasonable price. Manure containing a large proportion of undecayed straw or other coarse bedding should not be applied, because the decay of coarse straw or other woody materials results in the temporary depletion of the available nitrogen in the soil. This is likewise true of soil-improving crops used as substitutes for manure, and these should be turned under while green and in condition to decay quickly. Thorough disking of the material in advance of plowing will greatly facilitate the disintegration of the organic matter. Some of the most successful lettuce growers of the Atlantic coast region follow the practice of disking their soil before plowing and redisking it eight to twelve times after plowing.

The manure for use on lettuce land should be composted in a compact pile for at least three months and preferably six months in advance of being spread on the land. During this period the leachings from the pile should be collected in a pit and pumped over the pile of manure from time to time. If the manure is excessively dry at the time it is piled for composting, enough water should be added to cause it to decay rapidly. The manure is usually spread broadcast over the land with a spreader or by hand at the rate of 20 to 40 tons to the acre and thoroughly disked into the soil. One such application every three years interspersed with at least two soil-building crops will usually be sufficient to maintain the organic matter in the soil.

Commercial fertilizers analyzing from 5 to 7 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 5 to 6 per cent potash are used at the rate of 1 ton or more per acre for growing lettuce. Top-dressings of nitrate of soda at the rate of not more than 300 pounds to the acre, or other readily available sources of nitrogen in corresponding quantities, are frequently applied to the growing crop. The total quantity of fertilizer applied to a crop of lettuce will depend upon the fertility and character of the soil, but in view of the intensive character of the crop it requires high fertilization.

The time of applying fertilizers varies with the locality, but as a general rule the main application of commercial fertilizer is made just prior to planting and during soil preparation. The southern New Jersey lettuce growers follow the practice of applying 1 ton of bone meal to the acre during August or just before planting the fall crop. This gives a slowly available but constant source of plant food, especially of phosphorus. As a general rule, all fertilizers are spread broadcast and thoroughly disked into the soil. Top-dressings of nitrogenous fertilizers are not recommended after the heads begin to form, on account of the tendency to make the heads loose and of poor shipping quality.

LIME

Recent experiments conducted to determine the response of lettuce to applications of lime indicate that on many soils sufficiently supplied with plant food there is little or no response to lime; in fact, some of these experiments show harmful results when lime is applied. The Rhode Island Agricultural Experiment Station found that lettuce is benefited by applications of lime to the particular type of soil on which their experiments were conducted.

At the Virginia Truck Experiment Station near Norfolk, Va., T. C. Johnson and his associates found that the growth of both Big Boston and New York varieties of lettuce was improved by moderate applications of lime. These experiments were conducted on what is known as a Sassafras loam soil. Where the soil was extremely low in lime content and showed a decided acid reaction the lettuce made little or no growth, but where just enough lime was applied to bring the soil to a point slightly below neutral the lettuce made good growth. It was found, however, that where the reaction showed the soil to be neutral or alkaline there was a check in the development of the plants. The conclusions reached by those in charge of these experiments were "that high alkalinity does not seem to be conducive to good lettuce growth." Professor Crist, of the Michigan Agricultural College, in growing the Grand Rapids variety of lettuce in greenhouses found that the natural low lime content in the soils under investigation did not have much effect on the development of the crop, but that heavy applications of lime did have a depressing effect.

From these experiments it would appear that the lime requirement for lettuce is dependent almost wholly upon the local character and condition of the soil under treatment, and as a general principle lime should not be used unless shown to be necessary by a test of the soil in question. County agricultural agents are often prepared to make soil-acidity tests, or they can at least refer the matter to the

workers in their State colleges and experiment stations for a determination. Present knowledge of the subject would further indicate that heavy applications of lime are undesirable in lettuce growing and that the margin of safety is rather narrow.

SOIL PREPARATION

The method of preparing the soil for planting to lettuce varies with the locality. The peat soils of the Great Lakes region are usually plowed and harrowed with a tractor. These lands as a rule are divided by drainage ditches into beds about 75 or 100 feet in width and from 60 to 90 rods in length, adapting them to tractor preparation. The number of diskings and draggings necessary to get the peat soils in condition for planting will depend upon the

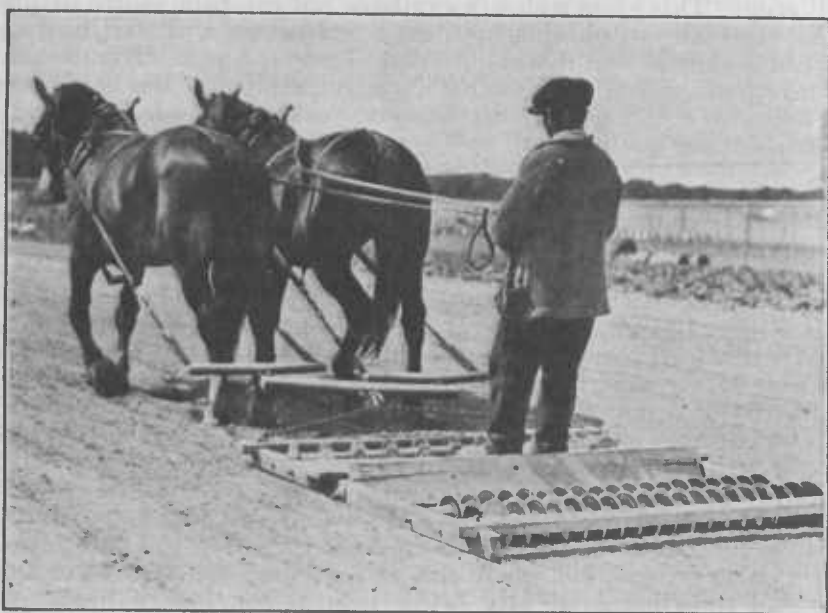


FIGURE 1.—Meeker harrow used for finishing the preparation of the soil before planting lettuce

length of time that the land has been under cultivation and the general character of the soil. The preparation, however, is usually completed by means of a plank drag or with a Meeker harrow (fig. 1), which leaves the soil with a smooth surface.

On the sandy soils of the Atlantic coast the plowing is done either with tractors or with teams, in many sections the land being bedded on 4-foot centers by means of 1-horse turning plows. In all cases the soil is harrowed and dragged until it is thoroughly pulverized before planting.

Lettuce grown in the irrigated regions of the West is planted on raised beds, the general custom being to grow two rows on a bed with irrigation furrows between the beds. In some sections of the West lettuce is planted in single rows on raised beds. It is essential that the beds should be of a uniform height, in order to avoid flood-

ing certain areas while others remain dry. For this reason the land should be carefully leveled following plowing in order to fill all depressions. This is usually done by means of a float consisting of planks set on edge but slightly inclined backward. In general, the soil should be plowed, disked, and harrowed to a fine mellow condition before the beds are made. When alfalfa land is broken preparatory to planting lettuce, it is given a deep plowing several months in advance and allowed to remain in a rough condition until about a month before planting. A second plowing is then given, followed by a light irrigation. As soon as the ground is dry it is disked and then leveled with a float, after which the beds are made.²

VARIETIES

The commercially important varieties of head lettuce being grown in the United States at present are New York, Iceberg, May King, Salamander, Hanson, and Big Boston and its variations. The greater part of the earload movement consists of three varieties—New York, Iceberg, and Big Boston. Grand Rapids and Early Curled Simpson are the two important varieties of loose-leaf lettuce grown for the Market in the United States; these two varieties, however, are of relatively little importance in the general ear-load distribution, except as grown in greenhouses.

New York.—(Also known under the names of Los Angeles, Imperial, and Wonderful.) This variety was first listed in this country about 30 years ago by Henderson. It is one of the most popular varieties, especially for planting in the western part of the United States. It is a curled and crisp-heading variety; heads large, dark green, and slightly curled on the edges. The head at first is pointed or conical, but becomes globular at maturity; outer leaves dark green in color, center leaves a pale green, overlapping and folding, making a compact head; outer leaves frequently spread to a diameter of 12 or 15 inches, center or solid part of head frequently 7 inches in diameter, the usual size being about 5 inches. The head has a crumpled appearance and is white inside. It is easily distinguished from Iceberg by its deeper green color of leaves and its freedom from reddish brown tinge on margin of the inner leaves. (Fig. 2.)

Iceberg.—Curled or crisp heading, medium large, medium green; leaves wavy with fringed edges; inner leaves tinged at margins with reddish brown; forms a large, compact, crumpled head, very white inside. When grown on good soil the heads, including the outer leaves, frequently measure 15 inches in diameter, the center or solid part being somewhat angular and 5 to 7 inches in diameter. It is lighter in color and has a slightly flatter head than New York. Under normal conditions it matures three to six days earlier than New York. This is the Iceberg variety type (fig. 3), although most of the lettuce appearing on eastern markets under the name "Iceberg" is of the variety known as New York, Los Angeles, Wonderful, or Imperial.

Big Boston.—Probably the most widely distributed variety in cultivation, Big Boston (fig. 4), is listed by practically every seed house in America and Europe. Heads are medium large, usually referred to as butter type; medium light green, with slight tinge of reddish brown on the margins of the inner leaves; leaves smooth and not blistered or savoyed. The head itself is tender and buttery, and the interior is of a light golden yellow; has a decided tendency to tipburn and does not withstand hot weather. This variety and its numerous strains have been planted almost exclusively for the earload production of the eastern United States. During recent years, however, several successful attempts have been made to grow New York and Iceberg in various parts of the East.

There is a strain of the Big Boston type which has light-green foliage, free from the reddish-brown tinting on the edges of the inner leaves, and which does

² From the following publication: JONES, H. A., and GARTHWAITE, E. L. THE GROWING AND HANDLING OF HEAD LETTUCE IN CALIFORNIA. Calif. Agr. Expt. Sta. Circ. 295, 36 p., illus. 1925.

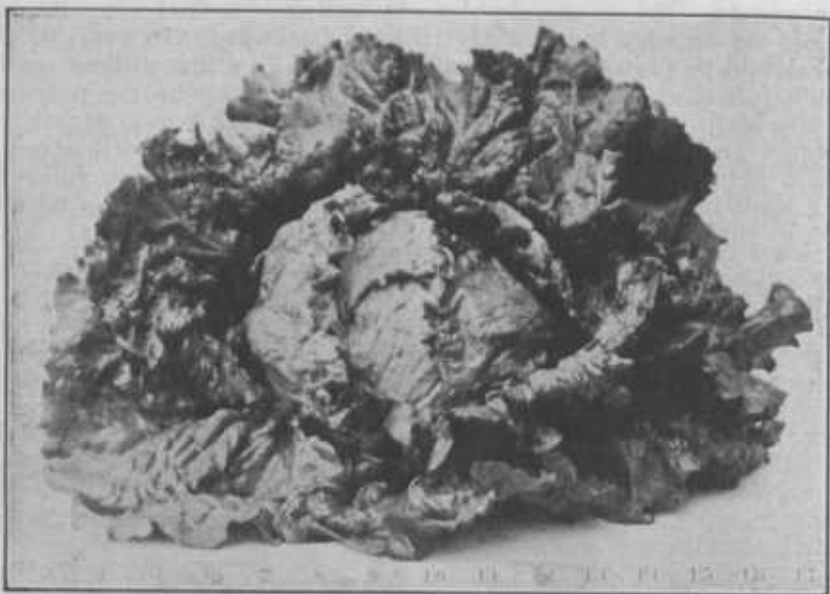


FIGURE 2.—Head of the New York variety of lettuce, also known as Los Angeles and Wonderful. This variety is sold under the trade name "Iceberg"

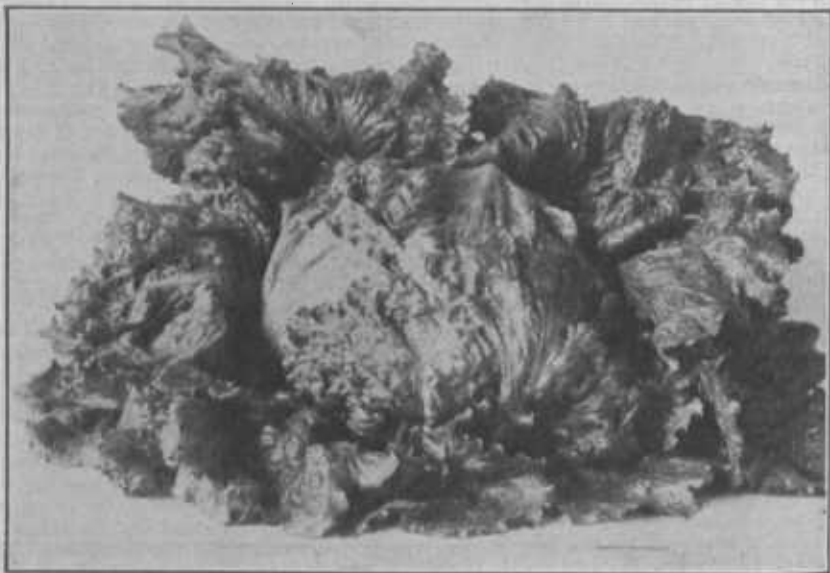


FIGURE 3.—Head of true Iceberg lettuce

not tipburn as does the regular Big Boston. Seed of this strain is sold under the names of White Big Boston, Unrivalled, and various local names. It is especially suitable for growing as a spring crop for the market and for home use.

May King.—One of the favorite varieties of head lettuce, especially in the northeastern part of the United States, is the May King (fig. 5), known as a butterhead type. It is an early variety and especially adapted for coldframe and outdoor culture in the spring. Heads are medium size to small, upright, and slightly pointed at first, but rounding out and forming a compact head at maturity; color of leaves light green, slightly tinged at edges with brown. It is grown extensively as a coldframe lettuce in the eastern United States.

Hanson.—Introduced many years ago, Hanson (fig. 6) is one of the best known of the old standard varieties. Heads medium to large; leaves curly, edges fringed and outer ones dark green. When well grown it forms a solid, white, crisp head, similar in many respects to New York, but the heads are usually smaller; matures rather early and shoots to seed quickly after maturity, especially under warm-weather conditions. Because of its fine quality, it is a desirable variety for the home and market garden.



FIGURE 4.—Typical head of Big Boston lettuce

Salamander (Black Seed Tennisball).—One of the five most popular varieties of head lettuce, Salamander (fig. 7) is a cabbage butterhead, of medium size, solid head; medium green; leaves crumpled, but straight on edges. It is excellent for early spring growing, matures about three days later than May King, shoots to seed quickly, and must be handled very promptly after heads are fully formed. The plants occasionally have the peculiar characteristics of throwing out numerous side shoots before heads are fully formed.

Romaine or Cos.—Romaine lettuce (fig. 8) is grown extensively for local marketing and to some extent for shipping. It is, however, of a type distinctly different from the ordinary head lettuce. Heads are large, upright, elongated, compact, but not hard; leaves long, narrow, dark green; inner leaves yellowish, bleaching to creamy whiteness; leaves folding at top of head; tipburns to some extent during warm weather; quality excellent, crisp, and tender; flavor rich, but delicate and pleasing; especially adapted for serving with vinegar dressing.

Grand Rapids.—Originated many years ago by Eugene Davis, of Grand Rapids, Mich., the Grand Rapids variety (fig. 9) is probably the best known and most popular of the loose-leaved nonheading sorts. It has been used very extensively as a greenhouse lettuce throughout the northeastern United States.

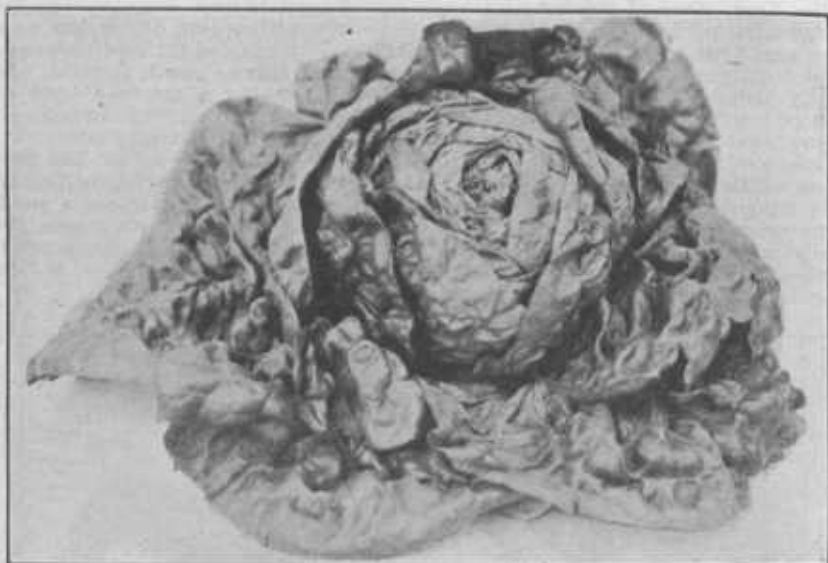


FIGURE 5.—Head of May King lettuce

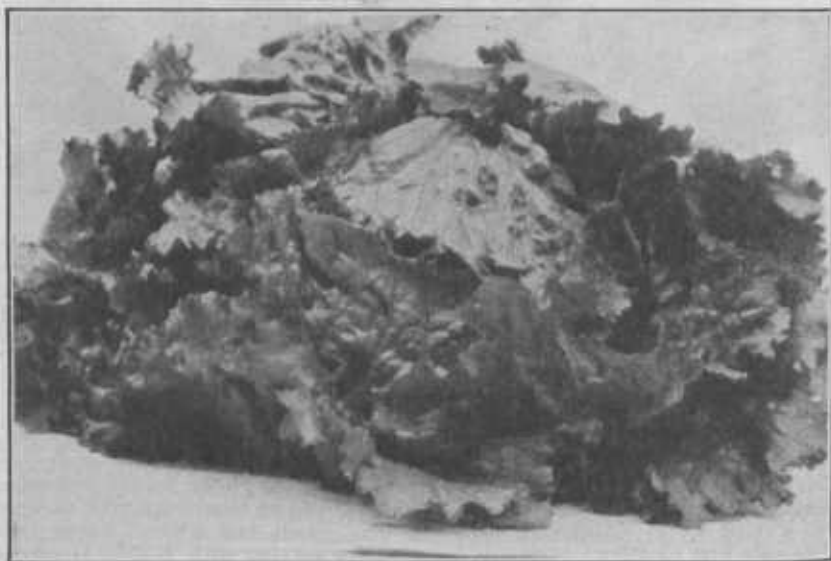


FIGURE 6.—Head of Hansen lettuce

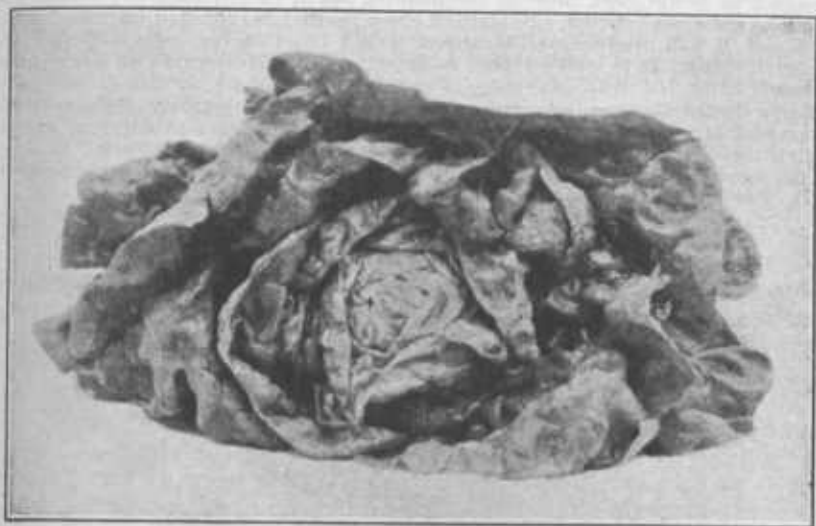


FIGURE 7.—Head of salamander lettuce

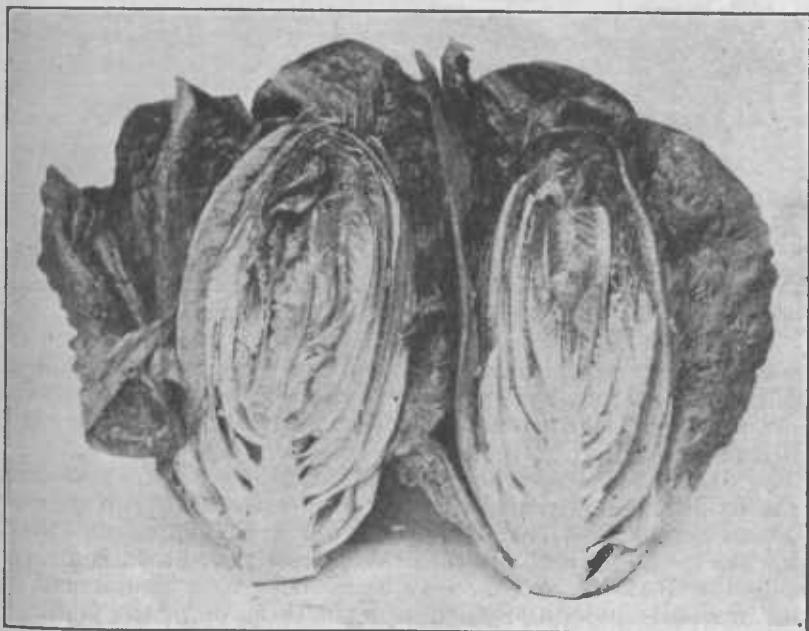


FIGURE 8.—Cross section of head of Romaine or Cos lettuce

It is grown in home gardens and in market gardens for local trade and withstands heat better than most of the heading sorts. The leaves are rather deep green in color and curled. If planted closely—that is, about 6 by 8 inches—on good soil, it will produce well-bleached, tender inner leaves, especially desirable for garnishing. It is well adapted to growing in coldframes as an early spring lettuce.

Early Curled Simpson.—A nonheading, bunching, crisp variety, light yellowish green and of large size. The texture of the leaves is fine and delicate, and the variety is used extensively by market gardeners for hotbed culture. It is one of the most popular American varieties of loose-leaf lettuce and withstands the heat of early summer better than the heading varieties.

SEED SUPPLY

Most of the lettuce seed used in the United States is grown in California. A few growers throughout the country follow the prac-

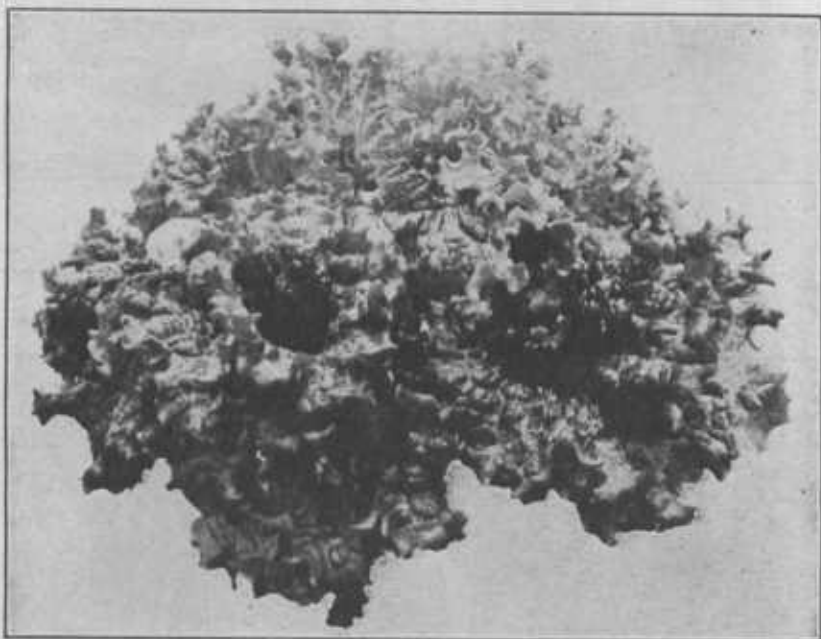


FIGURE 9.—Grand Rapids loose-leaf lettuce

tice of selecting special plants and growing their own seed, but as a rule greater uniformity and closer selection of type is obtained where the seed is grown in considerable quantities by commercial growers.

Where the lettuce seed is sown in beds and the seedlings transferred to the field, one-half pound of seed will produce enough plants to plant an acre. Most lettuce growers use 2 pounds of seed to the acre when seeding directly in the field, but with good seed and careful sowing the quantity of seed may be reduced to 1 pound and will result in a corresponding reduction in the thinning of the plants. A good grade of lettuce seed of any of the standard market varieties can generally be sold at prices from \$1 to \$1.50 a pound. In a few cases prices as high as \$3 or \$4 a pound are being charged for choice selections.

Lettuce seed retains its viability for several years if stored under proper conditions, but in order to obtain vigorous plants it is recommended that seed not more than 2 years old be planted. Strictly fresh lettuce seed, that is, seed that is planted the same season that it is grown, is likely to give a poor germination, and for that reason it is desirable to plant seed grown the previous season.

PLANTING

A large proportion of the commercial crop of head lettuce is started in beds and transplanted to the fields. The usual custom is to prepare seed beds either in hotbeds, in coldframes, or in the open ground, fertilize the soil of the seed bed somewhat highly, about 4 pounds of fertilizer per 100 square feet, and sow the seed thinly so as to produce strong, healthy plants. As heretofore stated, one-half pound of good seed planted in a special seed bed will produce enough plants with which to set an acre of lettuce. Approximately 50 coldframe sash 3 by 6 feet will be required for growing these plants. Where the beds are in the open and not covered with sash, a bed 100 feet long and 12 feet wide is recommended. While standard 3 by 6 foot hotbed or coldframe sash are frequently used for covering the beds, very good results can be obtained by making the beds 12 or 14 feet in width and covering them with muslin or tobacco cloth supported upon crosspieces of lath. Great care must be taken in the watering and ventilation of the plant beds in order to avoid severe losses by damping off. This disease seldom gives trouble in the open beds, except during seasons of excessive rainfall accompanied by warm weather.

Lettuce growers sometimes start the plants by drilling the seed in rows in the open ground, using an ordinary garden seed drill and spacing the rows 10 or 12 inches apart. Where the seed is sown in this manner the plants will be ready for setting in the field in from 30 to 40 days.

Successful head-lettuce production, especially in the eastern part of the United States, is dependent upon bringing the heads to maturity at a time when temperature conditions are favorable. The spring crop, where seeded in the open ground, is almost certain to run into the hot weather of early summer and fail to produce solid heads, shooting to seed before becoming marketable. To overcome this difficulty certain growers have adopted the practice of sowing the seed in greenhouses, in mild hotbeds, or in well-protected coldframes. By this method the plants are of considerable size when conditions will permit of their being set in the open ground. By planting as early as possible on well-prepared rich soil, the crop can be brought to maturity late in May or early in June, in advance of hot weather. Crops of New York, Iceberg, May King, and Big Boston, yielding upwards of 1,000 crates to the acre, are now occasionally being grown in this manner by eastern growers.

Lettuce grown on the muck areas of the Great Lakes region is practically all seeded in place and the plants thinned to a uniform stand. In the case of the late or fall crop in the eastern United States, the seed is planted in the field with a seed drill, and when the plants are well established they are thinned first by chopping out with a hoe and later by hand thinning to provide a uniform stand.

Planting distances vary with locality, depending upon the system of cultivation or irrigation. In the western sections where the crop is grown almost entirely by furrow irrigation, the usual custom is to plant on the 2-row bed, the beds being approximately 20 inches in width with a space of 14 inches between the rows on the beds. The irrigation furrow between the beds is usually 22 inches, making a total of 42 inches for the combined furrow and bed. The width of the bed, the distance between the beds, and the depth of the furrow vary according to the locality and the type of soil.

In Florida the greater part of the lettuce crop is grown by level culture on slightly raised beds, the distance between the rows on the beds being from 12 to 15 inches, so as to accommodate the wheel hoes used for cultivation. In the Wilmington (N. C.) district, head lettuce is grown both by single-row culture and by the bed method. When planted in single rows for horse cultivation, the rows are spaced 21 inches apart and the plants 9 inches apart in the rows, as



FIGURE 10.—Single-row planting system for horse cultivation

shown in Figure 10. By the 2-row bed method, the beds are spaced 4 feet apart, center to center, two rows of lettuce 15 to 18 inches apart being planted on top of each bed, as shown in Figure 11. Later in the season when the crop is nearly grown a row of cucumbers is planted in the center of the bed halfway between the rows of lettuce.

In the Norfolk-Portsmouth (Va.) district, lettuce is planted for the most part on 6-foot or 7-foot beds, six rows being planted on each bed, as shown in Figure 12. In southern New Jersey the plants are set in checkrows 12 to 15 inches apart in each direction so as to permit of cultivation both ways. (Fig. 13.) In northern New Jersey the plants are frequently set in double rows, the two rows being about 1 foot apart with a space of about 18 inches between the double rows. On the peat lands of the Great Lakes region (fig. 14) the rows are spaced 12 to 18 inches apart according to the type of cultivation employed. The plants of the smaller heading varieties are set 8 to 10 inches apart in the rows, whereas those of the large heading varieties,



FIGURE 11.—Double-row planting system on slight beds



FIGURE 12.—Lettuce planted on 6-foot beds



FIGURE 13.—Lettuce planted in checkrows



FIGURE 14.—Lettuce on peat lands of the Great Lakes region

such as New York and Iceberg, must be given at least 12 and preferably 15 inches in the row.

The work of setting the plants in the field is usually done by contract at so much a bed or an acre. The plants are lifted from the seed bed in baskets or trays and are hauled to the field, where they are dropped by boys or girls ahead of the planters. The planters follow closely and set the plants with small trowels or dibbers. To set an acre of lettuce with the rows 18 inches apart and the plants 12 inches apart in the rows will require approximately 29,000 plants, and the work can be done by a man and a boy in about three days. The cost of setting an acre of lettuce plants in the eastern United States varies from \$18 to \$30.

Throughout the Eastern States the fall-grown lettuce crop is usually seeded directly in the field. The rows are spaced 15 to 18 inches apart, either on narrow beds or on the level, and after the plants are established they are thinned to the desired distance, usually 9 inches apart in the rows for the smaller heading varieties. Gang seeders are frequently employed, but any seed drill of a standard make can be used for planting lettuce. The use of gang seeders insures greater uniformity in the width of rows and simplifies cultivation. The seed is usually sown about the first of August in New Jersey, Delaware, and eastern Maryland; in fact, lettuce planted any time during August in that section will, as a rule, make a fall crop in the open. Under favorable conditions, the plants will be well established and ready for the first thinning about two weeks after seeding.

On heavy land, especially the clay soils of the West, difficulty is experienced with the crusting of the surface, which interferes with the coming up of the seedlings. Where this occurs, the seed beds are sometimes covered by sifting a thin mulch of fine manure over the surface, or a thin layer of sand is sifted over the beds after seeding. Where the seed is sown in the field the drill may be fitted with a hopper from which a small stream of mulching material is scattered directly on the row over the seed. Keeping the soil moistened by means of frequent light irrigations is the most common method of preventing its baking over the lettuce seed. Another method is to keep the soil both cool and moist during the germination period by allowing a small stream of water to flow continuously through the furrows.

THINNING

Thinning is the most laborious task connected with the culture of lettuce. Transplanted lettuce does not require thinning in the field, but some replacements are usually necessary, while lettuce that is seeded in place will require careful thinning. The first thinning is usually done in from 10 days to 2 weeks after the seed is sown, the plants being simply blocked out by chopping with a hoe or by means of one of the modern thinning machines. In either case this method leaves the plants in clusters 8 to 10 inches apart with open spaces between them. Within two or three days after chopping out the plants it will be necessary to thin the clusters by hand to a single plant. The plants removed in thinning are often used for setting additional areas or for replacements. Many growers use a spoon as an aid in thinning. A special spoon about the size of a teaspoon can be made from a piece of steel, a wooden handle being supplied,

and if the edges are kept sharp this is very effective for cutting out the surplus plants. An ordinary teaspoon with the handle wrapped and the edges sharpened is fairly effective, or a hook made from a thin piece of steel can be effectively used. In the final analysis, however, a certain amount of thumb and finger thinning is necessary.

Where fall lettuce is being grown under irrigation in the Eastern States, it is probably more economical to grow the plants in a bed and transplant rather than to seed in place and thin. Without irrigation, however, it is very difficult to grow lettuce in the fall by transplanting, as the check incident to setting the plants under more or less dry conditions is too great.

CULTIVATION

Hand cultivation is used for the most part in the growing of lettuce, but in a few sections the rows are spaced so as to permit of horse cultivation. Small garden tractors are now being employed extensively, both for drawing the gangs of seed drills used in sow-

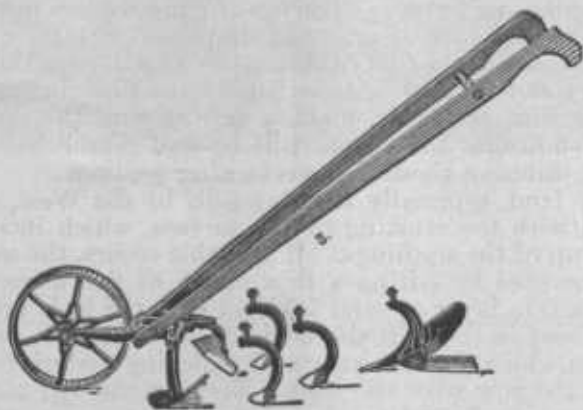


FIGURE 15.—Wheel hoe frequently used for cultivating lettuce

ing the lettuce and for its cultivation. The object of cultivation in lettuce growing is primarily the control of weeds, as the soil is thoroughly prepared before planting. Where the plants have been transplanted in check rows they can be cultivated in both directions until the heads begin to form. This will eliminate a large part of the handwork of hoeing and weeding. Where lettuce is seeded in place and thinned, it is impossible to have the plants in checks, thus restricting the cultivation to one direction only. The effectiveness of wheel-hoe and garden-tractor cultivation depends not only upon the use of the proper attachment but also upon the skill of the operator. Figure 15 shows a typical hand wheel hoe with the attachments for the various stages of lettuce cultivation. Figure 16 shows a typical small garden tractor in use for cultivating lettuce.

During the cultivation of the lettuce crop, highly nitrogenous fertilizers are frequently applied to stimulate growth. As a rule, about two applications of either nitrate of soda or some mixed fertilizer containing a high percentage of readily available nitrates are applied at the rate of 150 to 300 pounds per acre at each application. The

first application is usually made at the time the lettuce is given its second cultivation, and the second application about two weeks later. The fertilizer is sometimes sown broadcast when the plants are free from rain or dew and is immediately cultivated into the soil. A much better method, however, and one that precludes any possibility of burning the foliage, is to use a combination hand cultivator and fertilizer distributor which can be run between the rows of plants, thus distributing the fertilizer and working it into the soil at one operation.

The number or frequency of cultivations required to grow a crop of lettuce varies with the character of the soil, the seasonal conditions, and the growth of weeds. No definite rule can be laid down,



FIGURE 16.—Small garden tractor such as is used for cultivating lettuce

but generally four or five cultivations and one or two hoeings by hand should be sufficient to carry the crop through in good condition.

IRRIGATION

Lettuce requires a constant and fairly high moisture content in the soil, but excessive rainfall or irrigation will seriously damage the crop. On the other hand, lack of moisture in the soil will stunt the growth and produce poor heads. A moisture condition in the soil which is just a little greater than that required for good transplanting is satisfactory for the growing of lettuce. In other words, the moisture content of the soil should be just about as great as is permissible for cultivation. At no time except immediately following a rain or irrigation should the soil be so wet as to form balls

when squeezed in the hand. Extreme care must be taken in handling overhead irrigation that the soil does not become puddled from overwatering, and in no case should the plants become flooded. Water should be applied sparingly as the harvesting period approaches, in order to improve the carrying quality of the product. In general, less water is required for the fall crop than for the spring crop.

In sections having natural rainfall, the irrigation of the lettuce crop should be carefully studied from the standpoint of weather forecasts with relation to the condition of the soil moisture. The most expert growers keep a careful watch on both the weather and their lettuce crop, applying only enough water to carry the plants through until it rains. During continued dry weather, irrigations usually are given about once a week, or as actually needed. Lettuce grown in the eastern or humid regions requires from 5 to 8 inches



FIGURE 17.—Lettuce grown under overhead irrigation

of rainfall or its equivalent in irrigation to produce a spring crop, the amount being somewhat dependent upon the character of the soil, the percentage of cloudy weather, and the prevalence of winds. The ordinary overhead or spray system will distribute approximately 60 gallons of water per minute over an acre, thus requiring about four hours' watering to apply one-half inch of water over the entire surface, or sufficient to fairly saturate the soil. Figure 17 shows a field of lettuce grown under spray irrigation.

In the western lettuce-growing sections irrigation practices vary with the locality and the character of the soil. In heavy clay soils deep furrows are used with a small head or flow of water. If the water comes close to the top of the bed the soil will bake and crack when it dries, and the seedlings will not come through. It is best to irrigate sparingly when the plants are small, also when the crop is maturing. More frequent irrigations are needed on light sandy soils than on the clay loam soils. Less water is needed when the air

is cool and moist than when drying winds prevail. These and many other points regarding the growing of western head lettuce are covered in the bulletins issued by the States in which the crop is extensively grown.

INSECT ENEMIES OF THE LETTUCE CROP³

CUTWORMS

Fortunately, the lettuce plant is comparatively free from insect attack. There are a few pests, however, that cause considerable trouble to the lettuce grower. Cutworms are particularly destructive to the seedling crop. There are many kinds of cutworms. Some forms winter over in the soil in the immature worm stage, and as soon as the weather becomes favorable in the spring they are ready to attack the early-planted crop. Later in the season the crop may be damaged by cutworms that pass the winter in the egg stage. The crop is also subject to attack from worms that hatch from eggs laid by the moth in early spring and through the season. Cutworms damage the crop by cutting the plants off near the ground. They feed for the most part at night, spending the day inactive just below the surface of the soil.

Cutworms may be readily controlled by the timely use of a poisoned-bran bait, as shown in Table 3 and in the directions that follow.

TABLE 3.—*Poisoned bran bait for control of cutworms*

Ingredient	In small quantities	In large quantities
Dry bran.....	1 peck or 5 pounds.....	25 pounds.
White arsenic or Paris green.....	$\frac{1}{4}$ pound.....	1 pound.
Sirup or molasses.....	1 pint.....	2 quarts.
Water.....	3 or 4 quarts.....	15 to 20 quarts.

(1) Thoroughly dry mix the poison with the bran. This is important, as each particle of bran must carry a little poison in order to get a good kill. When making small quantities mix the bait in a bucket with a paddle, adding the poison slowly and stirring the bran at the same time. A more effective way is to mix the poison and the bran with the hands, but as soluble arsenic to a slight extent is absorbed through the pores of the skin, there may be some objection to this method. If the hands have any cuts, scratches, or other wounds, do not put them into the bait. When making large quantities, the poison can be mixed with the bran on some flat, smooth surface, using a shovel and rake in much the same way as in mixing concrete.

(2) Mix the sirup with the water.

(3) Add the water and sirup solution to the mixture of bran and poison, stirring slowly all the time. Large quantities of water added at one time will wash the poison from the bran, resulting in an uneven mixture.

Caution.—Add only enough liquid to make a crumbly mass. It is a good plan to set aside a little of the mixture of dry bran and arsenic so that if too much water has been used this reserve can be added to bring the mixture to the proper consistency. Large quantities can be made up in galvanized-iron or wooden wash tubs, and small quantities in buckets or similar containers.

How and when to use the bait.—Either broadcast the poisoned bait or sow it by hand along the rows or about the base of the plants late in the evening so that it will not dry out to any great extent before the worms become active. Because cutworms overwinter in the ground, it is a good plan to broadcast the

³ Prepared by W. H. White, Entomologist, Division of Truck-Crop Insects, Bureau of Entomology.

poisoned bait over the cultivated areas a few days before the crop comes up or is set in the field. Where plants are to be transplanted to the field, this method is particularly valuable. If hills are made for melons or tomatoes, apply the bait directly to the hills a few days before the crop is set in the field. Such applications will rid the field of many of the worms before the crop is subject to attack.

Quantity of bait to use: 10 to 15 pounds of the wet bait is sufficient for one application per acre. Where the bait is applied directly to the rows or hills, a smaller quantity will suffice. It may require two or three applications at intervals of two days to rid the field of the pests.

PLANT LICE AND OTHER PESTS

Plant lice or aphids sometimes attack the lettuce crop. These pests can best be controlled, especially on the young crop, by dusting with nicotine dust containing 2 per cent of nicotine. Apply the dust when the air temperature is above 70° F. and when the foliage of the plants is dry. Dusting operations can be more effectively carried on when there is little air movement. The dust should be applied so that it will reach the under side of the leaves of the plant, where the insects feed in the greatest abundance. This can be accomplished by using a duster equipped with a nozzle attachment which will direct the dust upward as it is discharged from the machine. The nozzle should be held near the ground so that the drifting dust will come to rest on the under side of the leaves. Nicotine dust should be applied to the crop not later than 10 days before harvest.

Several other kinds of insects, among which are the lettuce looper and general feeders such as army worms and wireworms, occasionally become troublesome. Up to the present time no entirely satisfactory method has been developed for the control of these pests, although arsenical treatments will control leaf feeders such as the lettuce looper, such treatments are not recommended on crops with edible foliage, except when the crop is in the earliest stages of development.⁴

DISEASES

Lettuce drop, due to a fungus, causes the stem of the plant to rot near the surface of the soil, presenting a soft water-soaked spot that spreads downward until the roots are decayed and at the same time working upward until the bases of the leaves are affected. This results in cutting off the water supply of the leaves, causing them to wilt and drop downward until finally the entire plant collapses. The disease develops rapidly in relatively cool, moist weather. The causal fungus may live for a year or more in the soil. It may withstand deep covering, but remain dormant within 1½ inches of the surface. Soil sterilization is the usual remedy in greenhouses, but in the field where this is impracticable clean culture and crop rotation are about the only methods of controlling the disease. Among the crops recommended for rotation with lettuce are sweet corn, tomatoes, potatoes, cucumbers, radishes, beets, spinach, and onions. Celery and cabbage should not be grown either with lettuce or in the rotation.

Anthraxnose is another disease attacking lettuce and is found on all varieties. The causal fungus is known to survive the winter in

⁴ For further information on the control of lettuce pests, consult the Bureau of Entomology of the United States Department of Agriculture.

diseased refuse left in lettuce fields. Rotation of crops is the best way to prevent this trouble.

Lettuce frequently suffers from a disease known as downy mildew. Crop rotation and the eradication of wild lettuce from the fence rows and near the lettuce field is recommended.

Damping off of the small lettuce plants, especially in the seed bed, is due to any one of a number of fungi. The symptoms of this trouble are a decay of the plants at the surface of the soil and a falling over of the plants themselves. Sterilizing the soil used in the seed bed, keeping the plants reasonably dry, and giving sufficient ventilation to keep the air fairly dry is the treatment usually recommended for the control of this disease. As a means of avoiding damping off of the plants, the soil used for the seed bed should be reasonably light and of a type that will dry readily. The fact that this disease causes losses only in the presence of an excess of moisture makes it possible to control it largely by the means already suggested. Crowding the plants too closely in the plant bed, thus preventing their drying readily after watering, is one of the most frequent causes of loss from damping off. Where plants are grown in flats or trays they can be watered by setting the trays in a shallow tank in which there is about 1 inch of water, thus permitting the water to rise in the soil from the bottom of the trays without wetting the surface.

There are numerous other diseases of lettuce such as bacterial wilt, rosette, marginal blight, bacterial rot, and mosaic. Tipburn of lettuce, which is considered a physiological disease, is very prevalent in certain varieties, especially Big Boston. Climatic conditions are largely responsible for losses from tipburn. Certain varieties are more resistant to tipburn than others.⁵

PREPARATION FOR MARKET

Lettuce intended for long-distance shipment for the most part is packed without washing; that intended for local marketing is washed and drained before packing. Eastern-grown outdoor lettuce which is shipped in carloads is packed almost entirely in the field. Western head lettuce is largely packed in central packing houses.

Under favorable conditions the greater part of a crop of lettuce can be harvested at one cutting, but it is often necessary to go over the field three or four times, each time cutting only the heads that are matured. The different cuttings, however, may usually be made within two or three days of one another. The maturity of lettuce is determined by both color and solidity. Immature heads are spongy and do not hold up well during transit and marketing. It frequently happens, however, that head lettuce matures and is at its best before the heads are solid. The solidity of the heads at maturity also depends to some degree upon variety. Heads of reasonable firmness and good quality should not be confused with those that are overgrown and which begin to form an enlarged core as shown in Figure 18. Heads that have begun to shoot to seed on account of overmaturity or hot weather are bitter, coarse, and of poor quality.

⁵ Lettuce growers who suffer any considerable losses to their crops from diseases should write to the U. S. Department of Agriculture or to their State experiment station regarding the specific disease and its control.

The common practice of lettuce growers is to distribute the crates or hampers along one side of the field and begin cutting at that point. Cutting is usually done as early in the morning as possible. Heads that have been frosted in the field should never be handled while in that condition. The first 10 or 12 rows of lettuce are cut and packed, and the containers are loaded upon the wagons or trucks for hauling to the car. Another section of 7 to 12 rows is then cut and packed and the trucks or wagons driven directly through the field for loading. In harvesting the lettuce the heads are cut close to the ground or slightly below it. As the heads are cut and slightly trimmed, they are packed directly into the containers or thrown into a window from which they are packed. In some cases, the cutters trim the heads, removing all discolored leaves and turning them upside down where cut. The packers immediately follow the cutters and pack the lettuce in the crates before it suffers from exposure. This system

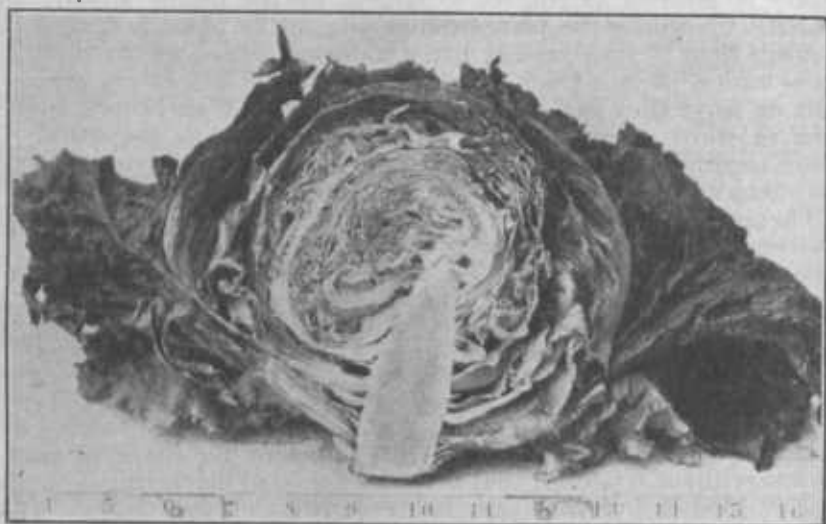


FIGURE 18.—Cross section of head of lettuce, showing enlarged core due to over-maturity

has the advantage that one man not only can pack behind two cutters but can do the work a little better than where the cutters do the packing themselves.

If not packed in the field, the heads are placed rather loosely in lug boxes or large crates and hauled from the field to the central packing houses.

Lettuce that is packed in the field can seldom be graded as uniformly as in a central packing house. The preference for field packing in the eastern districts is based largely on economy and expeditious handling; however, much depends upon the care exercised by the workers. Before packing, the heads are inspected and if necessary are given additional trimming to remove any dirt or undesirable leaves and to give the cut portion of the stem a neat, white appearance. The outer leaves are then slightly drawn together or folded over the head, and the heads are crowded just enough in the packages to make a firm but not tight pack. Although most of the outer leaves are

finally trimmed off before the heads are offered for sale, these outer leaves protect the head in transit. Heads that are trimmed too closely and do not have the outer leaves for protection should be discarded or placed in separate containers and marketed locally.

The United States Department of Agriculture has formulated standard grades for head lettuce which each year are being used more extensively.⁶

Lettuce is marketed in packages of various styles and sizes.⁷ The major portion, however, is handled in three types of containers, namely, the flat or New York crate, the large or western crate, and the hamper. Most of the crop grown in New Jersey and New York is marketed in the flat crate illustrated in Figure 19, the inside dimensions of which are 19 by 16 by 7½ inches, and which accommodates 24 medium-sized heads. A large part of the Florida crop is packed



FIGURE 19.—Packing lettuce in the 2-dozen crate, sometimes called the New York crate

in hampers of 28 and 32 quarts capacity. The greater part of the western-grown lettuce is packed in large crates the inside dimensions of which are 12½ by 18 by 22 inches, and which hold 36 to 60 heads, dependent upon the size.

In packing the small or flat crate the lettuce is placed in two layers, each consisting of 12 heads. The bottom layer is placed with the stems down and the top layer with the stems up. If the heads are too small to make a tight pack with 12 in each layer, the number to the layer is increased, but in either case they are arranged in definite rows rather than in a jumble or irregular pack.

⁶These Federal grades may be subject to slight revision from time to time and therefore are not given here. Copies may be procured without charge from the Bureau of Agricultural Economics, U. S. Department of Agriculture.

⁷Information on marketing lettuce is contained in the following publication and also in State publications: HAUCK, C. W. MARKETING LETTUCE. U. S. Dept. Agr. Bul. 1412, 45 p., illus. 1926.

Before being packed, the large or western crate is lined with heavy paper so placed as to lap over the top and the bottom, completely inclosing the contents after the crate is filled. The heads are usually packed in three layers, stems uppermost, each layer consisting of 12 to 20 heads, according to the size. A shovelful of finely crushed ice is placed between the layers, 20 to 30 pounds being used in each crate. This pack should be so tight that the cover slats will bulge about 1 inch. Where ice is placed in the crates, the work of packing must necessarily be done in a packing house, the lettuce being hauled in lug boxes from the fields to the packing house.

In packing lettuce in hampers, the bottom layer, usually consisting of three heads, is placed with the stems down, the second layer with the stems up, each succeeding layer being alternated, but with the top layer packed with the stems up. With medium and large



FIGURE 20.—Packing and lidding hampers of lettuce

heads of Big Boston 24 to 40 heads can be packed in a hamper with 7 or 8 heads in the top layer; with smaller heads the number varies and the top layer is increased to 9 or 11 heads. When the packing is completed and before lidding, the top layer should extend about $1\frac{1}{2}$ inches above the top of the hamper. In clamping on the lid the hamper may be slightly jarred and the lid pressed down even with the top. (Fig. 20.)

Lettuce is a perishable crop and requires extreme care in handling. To avoid exposure to sun and wind after the cutting and packing of the lettuce, the crates or hampers should be loaded upon trucks or wagons, covered with a light canvas, moved directly to the shipping point, and loaded into the cars. Lettuce that is to be packed in a central packing shed should be hauled to the packing shed promptly after it is cut, and there should be no delay in having it crated and placed under ice. Care in handling the heads, both in packing and in icing, is essential to prevent bruising. Rough han-

dling of the crates after they are packed should also be strictly avoided. Where the crates or hampers are packed in the field they are usually marked with the grade and the shipper's number by means of rubber stamps carried by the man doing the lidding. In some cases the crates or hampers are marked by the packers. Where the lettuce is packed in a central shed the marking is done by the packers or by the inspectors prior to placing the crates in the cars.

Transcontinental shipments of lettuce from the Imperial Valley of California take from 9 to 14 days to reach the large eastern markets, 10 or 11 days being the average time required in transit. Top or body icing, which consists in spreading a large quantity of broken ice over the top of the load in the car, is being employed in most cases, either with or without standard or bunker icing, depending on the time of the year. As a matter of fact, the greater part of the California crop of lettuce which moves during the winter months is loaded without initial bunker icing but with heavy top icing. Transportation companies have reconditioned many of their refrigerator cars, providing them with waterproof floors to meet the conditions brought about by top icing. Shipments from Arizona and Colorado moving at other times of the year from those of California require different treatment as to refrigeration, some of these shipments being loaded with initial icing in the bunkers of the cars without top icing, while later in the season when the cars must pass through high-temperature territory both bunker and top icing are employed.

The lettuce growers of the eastern United States have a shorter haul to the large consuming centers, enabling them to take advantage of market conditions and to get their produce to market without heavy refrigeration expense. However, even with the shorter distances it is essential to employ every means for keeping the lettuce cool and to avoid subjecting it to exposure.

MARKETING LOOSE-LEAF LETTUCE

Nonheading or leaf lettuce is grown in a limited way as an outdoor crop for local marketing, the Grand Rapids and Early Curled Simpson varieties being used mainly for this purpose. The Grand Rapids variety is grown very extensively in greenhouses, especially in Michigan, Indiana, Ohio, western Pennsylvania, and western New York, and is often shipped to the larger markets in solid carloads during the late fall, winter, and early spring months.⁸ Most of the greenhouse lettuce, however, is handled by express and by motor trucks. Leaf lettuce is sold mainly by the pound, and has been marketed in the past in 14-quart and 22-quart square-cornered splint baskets holding from 6 to 10 pounds, in standard bushel round-stave baskets holding 15 pounds, in standard 3-bushel barrels, and in used sugar barrels.⁹

⁸ For a more complete discussion of greenhouse lettuce, see the following publication: BEATTIE, J. H. Op. cit.

⁹ UNITED STATES LAWS, STATUTES, ETC. [STANDARD CONTAINER ACT.] U. S. Statutes at Large, pt. 1, p. 685-687. (U. S. Congress, 70th, 1st sess., Public, 462.) 1928. (Also published in the United States Department of Agriculture, Bureau of Agricultural Economics. Rules and regulations of the Secretary of Agriculture under the United States standard container act of 1928. U. S. Dept. Agr., Bur. Agr. Econ. Serv. and Regulat. Announc. 116, 5 p. 1928.)

Considerable quantities of loose-leaf lettuce are grown in cold-frames during the early spring and sold locally to stores and consumers. The greater part of this lettuce is handled in crates, bushel baskets, or in bushel boxes which are returned to the grower.

SOME ECONOMIC ASPECTS OF LETTUCE PRODUCTION

The cost of production of lettuce varies with the locality, but under nearly all conditions it is comparatively high. Satisfactory yields can be obtained only on the best soils. The crop requires the application of large quantities of fertilizers, and hand methods must be largely employed, resulting in high labor costs. The average yield of lettuce the country over is about one hundred and sixty 4-dozen or western crates to the acre, but cases are on record where yields of five hundred to seven hundred 4-dozen crates (one thousand to one thousand four hundred 2-dozen or eastern crates) to the acre have been obtained. The average farm price during the period from 1925 to 1928 was approximately \$1.56 a crate. On account of periodic overproduction of lettuce, the markets have frequently been oversupplied, resulting in prices below cost of production and transportation. The fact remains, however, that many growers are reaping a fair return from the production of lettuce.

Lettuce is grown on a large scale in about 15 States, but the greater part of the carload shipments is produced in 10 States. The period from 1920 to 1928 has witnessed a considerable increase in lettuce production, largely in California, Colorado, and Arizona. California alone shipped more than 33,000 cars of lettuce in 1928, or almost two-thirds of the entire movement for the country.

Future profits from lettuce growing, in both the Eastern and the Western States, will depend upon a careful adjustment to market requirements and a more thorough grading of the product. Present market conditions apparently do not warrant an expansion of the industry in any section, but there is ample opportunity for a marked improvement in quality and pack.

With the enormous increase in the production of western head lettuce and the flooding of the markets east of the Rocky Mountains with this product at prices often barely above cost of packing and transportation, the market season for the eastern grower has been largely reduced to the periods when the supply from the West has been light. Despite this fact, however, lettuce growing in the Eastern States during the last few years has been more profitable than in the Western States. According to the California Department of Agriculture, the packing and delivery costs of head lettuce in that State for 1927 were \$2.45 a crate above the actual cost of growing,¹⁰ but the records show that a considerable quantity of the crop for the year 1926 sold below that figure. The heavy production for the State, however, which was during the period from October to May, brought the general average of about \$3.50 per crate.

Growers of the eastern United States are now producing occasional good crops of New York and Iceberg lettuce, which are marketed at a profit during periods of high prices. The eastern grower, whose

¹⁰ ROGERS, S. S. FUTURE PRODUCTION OF HEAD LETTUCE IN CALIFORNIA. Calif. Dept. Agr. Mo. Bul. 16: 44-50, illus. 1927.

market is in the East or Middle West, has a decided advantage over his western neighbor from the standpoint of transportation, which on the product from the Imperial Valley of California is approximately \$1.70 a crate.

Considerable progress has been made during the last few years in the development of strains and varieties that are especially adaptable to local conditions. This is particularly true in the Imperial Valley of California, where a disease-resistant strain known as Imperial No. 2 is rapidly replacing the older variety, known as New York but sometimes called Los Angeles and Imperial. The Imperial No. 2 requires a longer period for its development than New York, and for that reason New York is being used mainly for early plantings. High-quality production and rigid standardization are necessary in order to maintain and develop the demand for lettuce.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

October 26, 1929

<i>Secretary of Agriculture</i> -----	ARTHUR M. HYDE.
<i>Assistant Secretary</i> -----	R. W. DUNLAP.
<i>Director of Scientific Work</i> -----	A. F. WOODS.
<i>Director of Regulatory Work</i> -----	WALTER G. CAMPBELL.
<i>Director of Extension Work</i> -----	C. W. WARBURTON.
<i>Director of Personnel and Business Administration.</i>	W. W. STOCKBERGER.
<i>Director of Information</i> -----	M. S. EISENHOWER.
<i>Solicitor</i> -----	R. W. WILLIAMS.
<i>Weather Bureau</i> -----	CHARLES F. MARVIN, <i>Chief.</i>
<i>Bureau of Animal Industry</i> -----	JOHN R. MOHLER, <i>Chief.</i>
<i>Bureau of Dairy Industry</i> -----	O. E. REED, <i>Chief.</i>
<i>Bureau of Plant Industry</i> -----	WILLIAM A. TAYLOR, <i>Chief.</i>
<i>Forest Service</i> -----	R. Y. STUART, <i>Chief.</i>
<i>Bureau of Chemistry and Soils</i> -----	H. G. KNIGHT, <i>Chief.</i>
<i>Bureau of Entomology</i> -----	C. L. MARLATT, <i>Chief.</i>
<i>Bureau of Biological Survey</i> -----	PAUL G. REDINGTON, <i>Chief.</i>
<i>Bureau of Public Roads</i> -----	THOMAS H. MACDONALD, <i>Chief.</i>
<i>Bureau of Agricultural Economics</i> -----	NILS A. OLSEN, <i>Chief.</i>
<i>Bureau of Home Economics</i> -----	LOUISE STANLEY, <i>Chief.</i>
<i>Plant Quarantine and Control Administration</i> -----	C. L. MARLATT, <i>Chief.</i>
<i>Grain Futures Administration</i> -----	J. W. T. DUVEL, <i>Chief.</i>
<i>Food, Drug, and Insecticide Administration</i> -----	WALTER G. CAMPBELL, <i>Director of</i> <i>Regulatory Work, in Charge.</i>
<i>Office of Experiment Stations</i> -----	E. W. ALLEN, <i>Chief.</i>
<i>Office of Cooperative Extension Work</i> -----	C. B. SMITH, <i>Chief.</i>
<i>Library</i> -----	CLARIBEL R. BARNETT, <i>Librarian.</i>

This bulletin is a contribution from

<i>Bureau of Plant Industry</i> -----	WILLIAM A. TAYLOR, <i>Chief.</i>
<i>Office of Horticultural Crops and Diseases</i> -----	E. C. AUCHTER, <i>Principal Horti-</i> <i>culturist, in Charge.</i>